IN THE UNITED STATES PATENT AND TRADEMARK OFFICE

Art Unit: 2123

Examiner: H. Jones

Applicant(s): G. Strumolo et al.

Serial No.: 09/432,485

Filing Date: November 1, 1999

For: PAINT SPRAY PARTICLE TRAJECTORY ANALYSIS METHOD AND SYSTEM

APPEAL BRIEF

Commissioner for Patents
P.O. Box 1450
Alexandria, Virginia 22313-1450

Sir:

By Notice of Appeal filed June 19, 2003, Applicants have appealed the Final Rejection dated March 19, 2003 and submit this brief in support of that appeal.

REAL PARTY IN INTEREST

The real party in interest is the Assignee, Ford Global Technologies, Inc.

RELATED APPEALS AND INTERFERENCES

There are no related appeals or interferences regarding the present application.

STATUS OF CLAIMS

Claims 1 through 6 have been rejected.

Claims 1 through 6 are being appealed.

CERTIFICATE OF MAILING: (37 C.F.R. 1.8) I hereby certify that this paper (along with any paper referred to as being attached or enclosed) is being deposited with the U.S. Postal Service with sufficient postage as First Class mail in an envelope addressed to: Commissioner for Patents, P.O. Box 1450, Alexandria, Virginia 22313-1450 on October 20, 2003, by Daniel H. Bliss.
Daniel H. Bliss

STATUS OF AMENDMENTS

An Amendment Under 37 C.F.R. 1.116 was filed on June 19, 2003 in response to the Final Office Action dated March 19, 2003. An Advisory Action dated July 16, 2003 indicated that the Amendment under 37 C.F.R. 1.116 would not be entered because it raised new issues that would require further consideration and/or search. The Advisory Action indicated that the Amendment under 37 C.F.R. 1.116 would not be entered for purposes of appeal. A Notice of Appeal, along with the requisite fees, was filed on June 19, 2003. The Appeal Brief, along with the requisite fee, is submitted herewith.

SUMMARY OF THE INVENTION

The present invention is a method of analyzing paint spray particle trajectories relative to a computer aided design (CAD) model representative of a portion of a vehicle with an external flow thereover. The method is intended to be carried out on a computer system which includes a computer having a memory, a processor, a display and user input mechanism, such as a mouse or keyboard, as subsequently described. In the present invention, the method starts in box 10 with a CAD model of a vehicle, or a desired portion of a vehicle, which is obtained from an electronic storage device, such as a computer file stored on a server memory, the memory of the computer, a magnetic disk storage device, or any one of numerous other electronic or magnetic storage devices.

Next, in box 12, a predetermined flow field over the CAD model, for example, representative of vehicle aerodynamics due to movement through the ambient is read in from an external source, for example, a stored file. The external flow field may be computed by various

commercial software programs, for example, PowerFlow™. This external flow field is computed relative to the exterior surface of the CAD model obtained in box 10.

Next, the method advances to block 16 where a simulated paint spray gun is placed relative to the CAD model. The paint spray gun is of an electrostatic type having a bell cup and housing, as well as a shaping air ring (FIG. 5). The paint spray gun is preferably located using an on-screen graphical user interface (GUI), in cooperation with the user input mechanism, preferably a mouse device as is known in the art. The screen GUI and mouse device permit a user to easily and dynamically place the paint spray gun at a desired location relative to the CAD model.

The method then advances to block 18 and information is specified about the particles which are simulated to be sprayed from the paint spray gun. This information may include, for example, particle size, particle velocity exiting the paint spray gun, particle density and other information describing particle characteristics. In box 20, the trajectories are computed according to known physical principles as further described below, and are computed with an external velocity field flow and electrostatic field flow.

After the particle trajectories have been computed, they are displayed relative to the CAD model in box 22. Various options for display of the particle trajectories may be chosen and an on-screen GUI may be used to ease user selection from among the display options.

Finally, in diamond 24, the user is given an option to dynamically relocate the paint spray gun, preferably using the screen GUI, in order to assess the performance of a new vehicle design, or to compare alternate vehicle designs, or to compare results from physical aerodynamic tests and a particular vehicle design.

Referring to FIG. 2, a method, according to the present invention, for enabling dynamic placement of a paint spray gun relative to a CAD design model representative of a desired portion of a vehicle to permit visual observation of spray trajectories with respect to the CAD model with external flow thereover is shown. In box 30, a CAD model of a vehicle is obtained as described above, which is preferably rendered on a display screen such as that seen in FIG. 3. The CAD model (FIG. 3) may include the whole vehicle or a desired portion thereof. Next, in box 32 of FIG. 2, a flow field around the external surface of the CAD model is read in for the specified CAD model. The flow field is preferably pre-computed based upon information supplied by a user regarding the particular vehicle CAD model and other external conditions affecting an external flow therearound. Typically, flow field data external to the vehicle is computed by a CFD program, as described above, and such information is saved to a computer file for later use with the method and system of the present invention.

After reading in the flow field, a rectangular box 102 may appear in the render window (FIG. 3). The box 102 shows a region in which flow field data is available. If desired, a user can crop this box, as well as sub-sample in it, to select only a subset of the data for the paint spray gun application, for example, by using vertical sliders 106 in a cropping/sub-sampling window 108 (FIG. 4). Such allows a reduction of the computer memory requirements in a computer system and potentially enables the method and system to run faster. Additionally, a two-dimensional slice of the external flow field can be displayed, as indicated by vectors 110 in FIG. 5, by selecting such in a velocity vector's window 112 (FIG. 6). A slice direction can be chosen to be along any one of the coordinate axes by selecting the appropriate button (X slice, Y slice, Z slice) and the magnitude of the velocity vectors can be controlled through a vertical slider 114 (FIG. 6).

Returning to FIG. 2, various information required for computing a paint spray trajectory is input in boxes 34 and 36. In box 34, a paint spray gun is located relative to a desired portion or target of the CAD model. Such placement can be accomplished using a screen GUI but also can be placed by using dials 116, 118, 120, for the X, Y and Z coordinates, respectively, in the main dialogue window 121 (FIG. 7). The spray gun is displayed in the render window 122 near a target portion of the vehicle (FIG. 5). In box 36 of FIG. 2, various paint spray information is specified. Such information is specified through the main dialogue window 121, for example, by typing in the desired droplet diameter to box 126 and by typing the droplet mass density into box 128. In addition, the inclination angle of the paint spray gun, that is the angle of the spray measured from the horizontal, and the base angle, that is the angle of the rotation of the spray about a vertical axis, can be specified by using the sliders 130,132, respectively, in the dialogue box 121 (FIG. 7). The trajectory of a single particle may be examined, as can the trajectories of multiple particles in the form of a spray. The number of particles and the spray angle may be input using box 144 and slider 136, respectively, in the main dialogue window 121. The paint spray gun may be dynamically altered in position, slope and inclination to reflect current user selections and to provide a visual aid for assessing resulting trajectories. After the paint spray gun has been positioned to a user satisfaction, trajectory calculations, with external flow, are performed (box 38, FIG. 2) by pressing a start button 138 in the main dialogue box 121 (FIG. 7). A user may select various trajectories 140, 148 and 150 to be rendered. Flow steam lines which are not affected by droplet size and which correspond to trajectories of massless particles, can also be rendered. These individual tracks can be displayed or hidden through the use of a "show/hide" button 146 in the main dialogue box 121 (FIG. 7).

Returning to FIG. 2, the diamond 44 inquires whether the paint spray gun must be modified, and if so, flow is routed to box 34 where the just described process of box 34 through 42 are repeated with the modified paint spray gun information. If there is not a desire to modify the paint spray gun, then a user may request a new run in diamond 46. If a new run is chosen, the choice is made of picking a new vehicle in diamond 48. If a new vehicle is chosen, flow is routed to box 30 and the process of box 30 through 42 are repeated. However, if a new vehicle is not chosen, the flow is routed to box 32 and the processes in boxes 34 through 42 are repeated.

ISSUE

The issues in this Appeal are statutorily formulated in 35 U.S.C. § 102 and 35 U.S.C. § 103. Specifically, one issue is whether the claimed invention of claims 1 through 6 are disclosed and anticipated under 35 U.S.C. § 102(b) by Miller et al. (SAE Paper No. 982291). Another issue is whether the claimed invention of claims 1 through 6 are disclosed and anticipated under 35 U.S.C. § 102(e) by Strumolo et al. (U.S. Patent No. 6,263,300). Yet another issue is whether the claimed invention of claims 1 through 6 are obvious and unpatentable under 35 U.S.C. § 103 over Kinema/SIM (ArSciMed, 1996) in view of Strumolo (U.S. Patent No. 5,568,404) or Miller et al. '291.

GROUPINGS OF CLAIMS

Claims 1 through 4 stand or fall together in regard to the rejection under 35 U.S.C. § 102(b).

Claims 1 through 4 stand or fall together in regard to the rejection under 35 U.S.C. § 102(e).

Claims 1 through 4 stand or fall together in regard to the rejection under 35 U.S.C. § 103.

Claim 5 stands or falls together in regard to the rejection under 35 U.S.C. § 102(b).

Claim 5 stands or falls together in regard to the rejection under 35 U.S.C. § 102(e).

Claim 5 stands or falls together in regard to the rejection under 35 U.S.C. § 103.

Claim 6 stands or falls together in regard to the rejection under 35 U.S.C. § 102(b).

Claim 6 stands or falls together in regard to the rejection under 35 U.S.C. § 102(e).

Claim 6 stands or falls together in regard to the rejection under 35 U.S.C. § 103.

ARGUMENT

35 U.S.C. § 102

As to patentability, 35 U.S.C. § 102(b) provides that a person shall be entitled to a patent unless:

> (b) the invention was patented or described in a printed publication in this or a foreign country or in public use or on sale in this country, more than one year prior to the date of application for patent in the United States.

A rejection grounded on anticipation under 35 U.S.C. § 102 is proper only where the subject matter claimed is identically disclosed or described in a reference. In other words, anticipation requires the presence of a single prior art reference which discloses each and every

element of the claimed invention arranged as in the claim. In re Arkley, 455 F.2d 586, 172 U.S.P.Q. 524 (C.C.P.A. 1972); Kalman v. Kimberly-Clark Corp., 713 F.2d 760, 218 U.S.P.Q. 781 (Fed. Cir. 1983); Lindemann Maschinenfabrik GMBH v. American Hoist & Derrick Co., 730 F.2d 1452, 221 U.S.P.Q. 481 (Fed. Cir. 1984).

As to the reference applied by the Examiner under 35 U.S.C. § 102(b), SAE Paper No. 982291 to Miller et al. discloses transient CFD simulations of a bell sprayer. Two numerical models are required in order to analyze the effect of paint transfer efficiency under varying bell operation conditions. First, the shaping air from a bell sprayer is simulated using a new computational fluid dynamics simulation, PowerFlow, as described in section 2.1. The numerical simulation is a single species, single-phase model and subsequently, paint spray dynamics and interaction with the shaping air must be modeled using a separate simulation. Section 2.2. describes SpraySIM which uses the flowfields from the CFD tool and calculates the drag the particles experience under the influence of the shaping air, gravity, and electric potential. Paint particle trajectories can then be calculated and paint transfer efficiency determined.

As to claim 1, claim 1 claims the present invention as a system for designing a vehicle by enabling dynamic placement of paint spray particles into a flow domain to permit visual observation and alteration of resulting particle trajectories under a computed flow solution over a computer aided design (CAD) model representative of a desired portion of the vehicle represented on a display by a computer having memory, a processor and a user input mechanism associated therewith. The system includes spray gun placement code means operable with the user input mechanism to dynamically effect a desired placement of at least one paint spray gun on the display with respect to the desired portion of the CAD model. The system also includes trajectory determination code means for computing at least one trajectory for a particle stream

emanating from the at least one paint spray gun relative to the desired portion of the CAD model for a predetermined set of particle characteristics in a predetermined set of particle external conditions. The system further includes trajectory display code means for effecting display of the at least one trajectory with respect to the desired portion of the CAD model.

Miller et al. '291 does not disclose the claimed invention of claims 1 through 4. Specifically, Miller et al. '291 merely discloses transient CFD simulations of a bell sprayer in which two numerical models are required in order to analyze the effect of paint transfer efficiency under varying bell operation conditions. Miller et al. '291 lacks spray gun placement code means operable with a user input mechanism to dynamically effect a desired placement of at least one paint spray gun on a display with respect to a desired portion of a CAD model. In Miller et al. '291, the SAE paper merely describes transient CFD simulations of a bell sprayer, but not how to use the bell sprayer or the logic behind its use as it relates to a vehicle as claimed by Applicants. Additionally, in Miller et al. '291, the SAE paper only describes the results of using a system, according to the present invention, and details of how the vehicle design is introduced, the flow fields calculated, and how one interacts with the system to produce an analysis (and modify the paint spray system for additional analyses) is not shown. Further, in Miller et al. '291, the SAE paper predicts paint spray trajectory, but does not disclose means operable with a user input mechanism to effect placement of a paint spray gun on a display with respect to a CAD model of a vehicle as claimed in claims 1 through 4. The Examiner has not shown in Miller et al. '291 where such feature is expressly disclosed.

Based on the above, Miller et al. '291 fails to disclose the combination of a paint spray particle trajectory analysis system including spray gun placement code means operable with a user input mechanism to dynamically effect a desired placement of at least one paint spray gun

on a display with respect to a desired portion of a CAD model and trajectory determination code means for computing at least one trajectory for a particle stream emanating from the at least one paint spray gun relative to the desired portion of the CAD model for a predetermined set of particle characteristics in a predetermined set of particle external conditions as claimed by Applicants. Miller et al. '291 fails to disclose each and every element of the claimed combination of a paint spray particle trajectory analysis system as arranged in the claims and claimed by Applicants. As a result, the Miller et al. '291 SAE paper cannot be an anticipatory reference under 35 U.S.C. § 102(b) to claims 1 through 4 of the present application.

Against this background, it is submitted that the present invention is not anticipated in view of the disclosure of Miller et al. '291. The reference fails to disclose each and every element of the claimed combination of a system for designing a vehicle by enabling dynamic placement of paint spray particles into a flow domain to permit visual observation and alteration of resulting particle trajectories under a computed flow solution over a computer aided design (CAD) model representative of a desired portion of the vehicle represented on a display by a computer as claimed by Applicants. Therefore, it is respectfully submitted that claims 1 through 4 are not anticipated and are allowable over the rejection under 35 U.S.C. § 102(b).

As to claim 5, claim 5 claims the present invention as a method for designing a vehicle using particle trajectory analysis with a computer aided design (CAD) model representative of the vehicle. The method includes the steps of preparing a CAD model of a desired portion of the vehicle and placing a paint spray gun at a desired location with respect to the desired portion of the vehicle. The method also includes the steps of specifying a set of particle information describing particles to be sprayed from the paint spray gun and computing a trajectory for a particle stream emanating from the paint spray gun. The method further includes

the steps of displaying the trajectory relative to the desired portion of the vehicle on a display to permit visual observation thereof and repositioning the paint spray gun if necessary to achieve a desired trajectory.

Moreover, Miller et al. '291 does not disclose the claimed invention of claim 5. Specifically, Miller et al. '291 merely discloses transient CFD simulations of a bell sprayer in which two numerical models are required in order to analyze the effect of paint transfer efficiency under varying bell operation conditions. Miller et al. '291 lacks preparing a CAD model of a desired portion of a vehicle, placing a paint spray gun at a desired location with respect to the desired portion of the vehicle, displaying the trajectory relative to the desired portion of the vehicle on a display to permit visual observation thereof, and repositioning the paint spray gun if necessary to achieve a desired trajectory. In Miller et al. '291, the SAE paper merely describes transient CFD simulations of a bell sprayer, but not how to use the bell sprayer or the logic behind its use as it relates to a vehicle as claimed by Applicants. Additionally, in Miller et al. '291, the SAE paper only describes the results of using a system, according to the present invention, and details of how the vehicle design is introduced, the flow fields calculated, and how one interacts with the system to produce an analysis (and modify the paint spray system for additional analyses) is not shown. In claim 5, Applicants are claiming preparing a CAD model of a desired portion of a vehicle, placing a paint spray gun at a desired location with respect to the desired portion of the vehicle, displaying the trajectory relative to the desired portion of the vehicle on a display to permit visual observation thereof, and repositioning the paint spray gun if necessary to achieve a desired trajectory. Once again, the Examiner has failed to show in Miller et al. '291 where such steps are disclosed.

Based on the above, Miller et al. '291 fails to disclose the combination of a method for designing a vehicle using particle trajectory analysis with a computer aided design (CAD) model representative of the vehicle including the steps of preparing a CAD model of a desired portion of the vehicle, placing a paint spray gun at a desired location with respect to the desired portion of the vehicle, specifying a set of particle information describing particles to be sprayed from the paint spray gun, computing a trajectory for a particle stream emanating from the paint spray gun, displaying the trajectory relative to the desired portion of the vehicle on a display to permit visual observation thereof, and repositioning the paint spray gun if necessary to achieve a desired trajectory as claimed by Applicants. Miller et al. '291 fails to disclose each and every step of the claimed combination of a method for designing a vehicle using particle trajectory analysis as arranged in the claims and claimed by Applicants. As a result, the Miller et al. '291 SAE paper cannot be an anticipatory reference under 35 U.S.C. § 102(b) to claim 5 of the present application.

Against this background, it is submitted that the present invention is not anticipated in view of the disclosure of Miller et al. '291. The reference fails to disclose each and every element of the claimed combination of a method for designing a vehicle using particle trajectory analysis with a computer aided design (CAD) model representative of the vehicle as claimed by Applicants. Therefore, it is respectfully submitted that claim 5 is not anticipated and is allowable over the rejection under 35 U.S.C. § 102(b).

As to claim 6, claim 6 claims a method for designing a motor vehicle by enabling dynamic placement of paint spray particles into a flow domain to permit visual observation and alteration of resulting particle trajectories with respect to a computer aided design (CAD) model representative of the vehicle. The method includes the steps of storing a first set of data

representing a CAD model of a desired portion of the vehicle into a computer memory and displaying the first set of data on a video display screen. The method also includes the steps of placing at least one paint spray gun at a desired location with respect to the desired portion of the vehicle by storing a second set of data representing the at least one paint spray gun in the computer memory and storing a third set of data in the computer memory representing particle information describing particles to be sprayed from the paint spray gun. The method includes the steps of computing a fourth set of data representing a trajectory for a particle stream emanating from the paint spray gun using the first, second and third sets of data and displaying the fourth set of data representing a trajectory relative to the first set of data representing a desired portion of the vehicle on the video display screen to permit visual observation thereof. The method further includes the steps of dynamically repositioning the paint spray gun if necessary to achieve a desired trajectory by manipulating the second set of data in the computer memory.

Moreover, Miller et al. '291 does not disclose the claimed invention of claim 6. Specifically, Miller et al. '291 merely discloses transient CFD simulations of a bell sprayer in which two numerical models are required in order to analyze the effect of paint transfer efficiency under varying bell operation conditions. Miller et al. '291 lacks storing a first set of data representing a CAD model of a desired portion of the vehicle into a computer memory, displaying the first set of data on a video display screen, placing at least one paint spray gun at a desired location with respect to the desired portion of the vehicle by storing a second set of data representing the at least one paint spray gun in the computer memory, storing a third set of data in the computer memory representing particle information describing particles to be sprayed from the paint spray gun, computing a fourth set of data representing a trajectory for a particle stream emanating from the paint spray gun using the first, second and third sets of data, displaying the

fourth set of data representing a trajectory relative to the first set of data representing a desired portion of the vehicle on the video display screen to permit visual observation thereof, and dynamically repositioning the paint spray gun if necessary to achieve a desired trajectory by manipulating the second set of data in the computer memory. In Miller et al. '291, the SAE paper merely describes transient CFD simulations of a bell sprayer, but not how to use the bell sprayer or the logic behind its use as it relates to a vehicle as claimed by Applicants. Additionally, in Miller et al. '291, the SAE paper only describes the results of using a system, according to the present invention, and details of how the vehicle design is introduced, the flow fields calculated, and how one interacts with the system to produce an analysis (and modify the paint spray system for additional analyses) is not shown. In claim 6, Applicants are claiming storing a first set of data representing a CAD model of a desired portion of the vehicle into a computer memory, displaying the first set of data on a video display screen, placing at least one paint spray gun at a desired location with respect to the desired portion of the vehicle by storing a second set of data representing the at least one paint spray gun in the computer memory, storing a third set of data in the computer memory representing particle information describing particles to be sprayed from the paint spray gun, computing a fourth set of data representing a trajectory for a particle stream emanating from the paint spray gun using the first, second and third sets of data, displaying the fourth set of data representing a trajectory relative to the first set of data representing a desired portion of the vehicle on the video display screen to permit visual observation thereof, and dynamically repositioning the paint spray gun if necessary to achieve a desired trajectory by manipulating the second set of data in the computer memory. Once again, the Examiner has failed to show in Miller et al. '291 where such steps are disclosed.

Based on the above, Miller et al. '291 fails to disclose the combination of a method for designing a motor vehicle by enabling dynamic placement of paint spray particles into a flow domain to permit visual observation and alteration of resulting particle trajectories with respect to a computer aided design (CAD) model representative of the vehicle including the steps of storing a first set of data representing a CAD model of a desired portion of the vehicle into a computer memory, displaying the first set of data on a video display screen, placing at least one paint spray gun at a desired location with respect to the desired portion of the vehicle by storing a second set of data representing the at least one paint spray gun in the computer memory, storing a third set of data in the computer memory representing particle information describing particles to be sprayed from the paint spray gun, computing a fourth set of data representing a trajectory for a particle stream emanating from the paint spray gun using the first, second and third sets of data, displaying the fourth set of data representing a trajectory relative to the first set of data representing a desired portion of the vehicle on the video display screen to permit visual observation thereof, and dynamically repositioning the paint spray gun if necessary to achieve a desired trajectory by manipulating the second set of data in the computer memory as claimed by Applicants. Miller et al. '291 fails to disclose each and every step of the claimed combination of a method for designing a motor vehicle by enabling dynamic placement of paint spray particles into a flow domain to permit visual observation and alteration of resulting particle trajectories with respect to a computer aided design (CAD) model representative of the vehicle as arranged in the claims and claimed by Applicants. As a result, the Miller et al. '291 SAE paper cannot be an anticipatory reference under 35 U.S.C. § 102(b) to claim 6 of the present application.

Against this background, it is submitted that the present invention is not anticipated in view of the disclosure of Miller et al. '291. The reference fails to disclose each and

every element of the claimed combination of a method for designing a motor vehicle by enabling dynamic placement of paint spray particles into a flow domain to permit visual observation and alteration of resulting particle trajectories with respect to a computer aided design (CAD) model representative of the vehicle as claimed by Applicants. Therefore, it is respectfully submitted that claim 6 is not anticipated and is allowable over the rejection under 35 U.S.C. § 102(b).

As to the reference applied by the Examiner under 35 U.S.C. § 102(e), U.S. Patent No. 6,263,300 to Strumolo et al. discloses a particle trajectory analysis system and method for vehicle design. In box 10, a CAD model of a vehicle, or a desired portion of a vehicle, is obtained from an electronic storage device. In diamond 12, an option is given to use a computed external flow over the CAD model. If flow is desired, then a predetermined flow field is read in from an external source in box 14. If it is determined that flow is not needed in diamond 12, flow is routed to box 16 where a simulated particle injector is placed relative to the CAD model. In box 18, information is specified about the particles, which are simulated to be ejected from the particle injector. Computations of particle trajectories are carried out in box 20. The particles may be liquid droplets, paint droplets, solid stone representations, or other physical representations.

In contradistinction, claim 1 claims the present invention as a system for designing a vehicle by enabling dynamic placement of paint spray particles into a flow domain to permit visual observation and alteration of resulting particle trajectories under a computed flow solution over a computer aided design (CAD) model representative of a desired portion of the vehicle represented on a display by a computer having memory, a processor and a user input mechanism associated therewith. The system includes spray gun placement code means operable with the user input mechanism to dynamically effect a desired placement of at least one paint spray gun on

the display with respect to the desired portion of the CAD model. The system also includes trajectory determination code means for computing at least one trajectory for a particle stream emanating from the at least one paint spray gun relative to the desired portion of the CAD model for a predetermined set of particle characteristics in a predetermined set of particle external conditions. The system further includes trajectory display code means for effecting display of the at least one trajectory with respect to the desired portion of the CAD model.

Strumolo et al. '300 does not disclose or anticipate the claimed invention of claims 1 through 4. Specifically, Strumolo et al. '300 merely discloses a particle trajectory analysis system and method for vehicle design having a simulated particle injector placed relative to a CAD model and computations of particle trajectories carried out with the particles being paint droplets. Strumolo et al. '300 lacks spray gun placement code means operable with a user input mechanism to dynamically effect a desired placement of at least one paint spray gun on a display with respect to a desired portion of a CAD model and trajectory determination code means for computing at least one trajectory for a particle stream emanating from the at least one paint spray gun relative to the desired portion of the CAD model for a predetermined set of particle characteristics in a predetermined set of particle external conditions. The Examiner even admits on page 9 of the final Office Action that Strumolo et al. '300 does not teach particle trajectories of paint droplets. Further, the present invention accounts for a new external force field to influence the trajectories of the flow, namely the electrostatic field and the dynamics of the present invention are considerably different from the one in Strumolo et al. '300. As a result, Strumolo et al. '300 cannot disclose the combination of a paint spray particle trajectory analysis method and system including spray gun placement code means operable with a user input mechanism to dynamically effect a desired placement of at least one paint spray gun on a display

with respect to a desired portion of a CAD model and trajectory determination code means for computing at least one trajectory for a particle stream emanating from the at least one paint spray gun relative to the desired portion of the CAD model for a predetermined set of particle characteristics in a predetermined set of particle external conditions as claimed by Applicants. Strumolo et al. '300 fails to disclose each and every element of the claimed combination of a paint spray particle trajectory analysis method and system as arranged in the claims and claimed by Applicants. Additionally, the subject matter of Strumolo et al. '300 and the claimed invention of claims 1 through 4 were, at the time the invention was made, owned by Ford Global Technologies, Inc. or subject to an obligation of assignment to Ford Global Technologies, Inc.

Against this background, it is submitted that the present invention is not anticipated in view of the disclosure of Strumolo et al. '300. The reference fails to disclose each and every element of the claimed combination of a system for designing a vehicle by enabling dynamic placement of paint spray particles into a flow domain to permit visual observation and alteration of resulting particle trajectories under a computed flow solution over a computer aided design (CAD) model representative of a desired portion of the vehicle represented on a display by a computer as claimed by Applicants. Therefore, it is respectfully submitted that claims 1 through 4 are not anticipated and are allowable over the rejection under 35 U.S.C. § 102(e).

As to claim 5, claim 5 claims the present invention as a method for designing a vehicle using particle trajectory analysis with a computer aided design (CAD) model representative of the vehicle. The method includes the steps of preparing a CAD model of a desired portion of the vehicle and placing a paint spray gun at a desired location with respect to the desired portion of the vehicle. The method also includes the steps of specifying a set of particle information describing particles to be sprayed from the paint spray gun and computing a

trajectory for a particle stream emanating from the paint spray gun. The method further includes the steps of displaying the trajectory relative to the desired portion of the vehicle on a display to permit visual observation thereof and repositioning the paint spray gun if necessary to achieve a desired trajectory.

Strumolo et al. '300 does not disclose or anticipate the claimed invention of claim 5. Specifically, Strumolo et al. '300 merely discloses a particle trajectory analysis system and method for vehicle design having a simulated particle injector placed relative to a CAD model and computations of particle trajectories carried out with the particles being paint droplets. Strumolo et al. '300 lacks preparing a CAD model of a desired portion of a vehicle, placing a paint spray gun at a desired location with respect to the desired portion of the vehicle, displaying the trajectory relative to the desired portion of the vehicle on a display to permit visual observation thereof, and repositioning the paint spray gun if necessary to achieve a desired trajectory. The Examiner even admits on page 9 of the final Office Action that Strumolo et al. '300 does not teach particle trajectories of paint droplets. Further, the present invention accounts for a new external force field to influence the trajectories of the flow, namely the electrostatic field and the dynamics of the present invention are considerably different from the one in Strumolo et al. '300.

Based on the above, Strumolo et al. '300 fails to disclose the combination of a method for designing a vehicle using particle trajectory analysis with a computer aided design (CAD) model representative of the vehicle including the steps of preparing a CAD model of a desired portion of the vehicle, placing a paint spray gun at a desired location with respect to the desired portion of the vehicle, specifying a set of particle information describing particles to be sprayed from the paint spray gun, computing a trajectory for a particle stream emanating from the

paint spray gun, displaying the trajectory relative to the desired portion of the vehicle on a display to permit visual observation thereof, and repositioning the paint spray gun if necessary to achieve a desired trajectory as claimed by Applicants. Strumolo et al. '300 fails to disclose each and every step of the claimed combination of a method for designing a vehicle using particle trajectory analysis as arranged in the claims and claimed by Applicants. As a result, Strumolo et al. '300 cannot be an anticipatory reference under 35 U.S.C. § 102(e) to claim 5 of the present application. Additionally, the subject matter of Strumolo et al. '300 and the claimed invention of claim 5 were, at the time the invention was made, owned by Ford Global Technologies, Inc. or subject to an obligation of assignment to Ford Global Technologies, Inc.

Against this background, it is submitted that the present invention is not anticipated in view of the disclosure of Strumolo et al. '300. The reference fails to disclose each and every element of the claimed combination of a method for designing a vehicle using particle trajectory analysis with a computer aided design (CAD) model representative of the vehicle as claimed by Applicants. Therefore, it is respectfully submitted that claim 5 is not anticipated and is allowable over the rejection under 35 U.S.C. § 102(e).

As to claim 6, claim 6 claims a method for designing a motor vehicle by enabling dynamic placement of paint spray particles into a flow domain to permit visual observation and alteration of resulting particle trajectories with respect to a computer aided design (CAD) model representative of the vehicle. The method includes the steps of storing a first set of data representing a CAD model of a desired portion of the vehicle into a computer memory and displaying the first set of data on a video display screen. The method also includes the steps of placing at least one paint spray gun at a desired location with respect to the desired portion of the vehicle by storing a second set of data representing the at least one paint spray gun in the

computer memory and storing a third set of data in the computer memory representing particle information describing particles to be sprayed from the paint spray gun. The method includes the steps of computing a fourth set of data representing a trajectory for a particle stream emanating from the paint spray gun using the first, second and third sets of data and displaying the fourth set of data representing a trajectory relative to the first set of data representing a desired portion of the vehicle on the video display screen to permit visual observation thereof. The method further includes the steps of dynamically repositioning the paint spray gun if necessary to achieve a desired trajectory by manipulating the second set of data in the computer memory.

Strumolo et al. '300 does not disclose or anticipate the claimed invention of claim 6. Specifically, Strumolo et al. '300 merely discloses a particle trajectory analysis system and method for vehicle design having a simulated particle injector placed relative to a CAD model and computations of particle trajectories carried out with the particles being paint droplets. Strumolo et al. '300 lacks storing a first set of data representing a CAD model of a desired portion of the vehicle into a computer memory, displaying the first set of data on a video display screen, placing at least one paint spray gun at a desired location with respect to the desired portion of the vehicle by storing a second set of data representing the at least one paint spray gun in the computer memory, storing a third set of data in the computer memory representing particle information describing particles to be sprayed from the paint spray gun, computing a fourth set of data representing a trajectory for a particle stream emanating from the paint spray gun using the first, second and third sets of data, displaying the fourth set of data representing a trajectory relative to the first set of data representing a desired portion of the vehicle on the video display screen to permit visual observation thereof, and dynamically repositioning the paint spray gun if necessary to achieve a desired trajectory by manipulating the second set of data in the computer

memory. The Examiner even admits on page 9 of the final Office Action that Strumolo et al. '300 does not teach particle trajectories of paint droplets. Further, the present invention accounts for a new external force field to influence the trajectories of the flow, namely the electrostatic field and the dynamics of the present invention are considerably different from the one in Strumolo et al. '300.

Based on the above, Strumolo et al. '300 fails to disclose the combination of a method for designing a motor vehicle by enabling dynamic placement of paint spray particles into a flow domain to permit visual observation and alteration of resulting particle trajectories with respect to a computer aided design (CAD) model representative of the vehicle including the steps of storing a first set of data representing a CAD model of a desired portion of the vehicle into a computer memory, displaying the first set of data on a video display screen, placing at least one paint spray gun at a desired location with respect to the desired portion of the vehicle by storing a second set of data representing the at least one paint spray gun in the computer memory, storing a third set of data in the computer memory representing particle information describing particles to be sprayed from the paint spray gun, computing a fourth set of data representing a trajectory for a particle stream emanating from the paint spray gun using the first, second and third sets of data, displaying the fourth set of data representing a trajectory relative to the first set of data representing a desired portion of the vehicle on the video display screen to permit visual observation thereof, and dynamically repositioning the paint spray gun if necessary to achieve a desired trajectory by manipulating the second set of data in the computer memory as claimed by Applicants. Strumolo et al. '3001 fails to disclose each and every step of the claimed combination of a method for designing a motor vehicle by enabling dynamic placement of paint spray particles into a flow domain to permit visual observation and alteration of resulting particle

trajectories with respect to a computer aided design (CAD) model representative of the vehicle as arranged in the claims and claimed by Applicants. As a result, Strumolo et al. '300 cannot be an anticipatory reference under 35 U.S.C. § 102(e) to claim 6 of the present application. Additionally, the subject matter of Strumolo et al. '300 and the claimed invention of claim 6 were, at the time the invention was made, owned by Ford Global Technologies, Inc. or subject to an obligation of assignment to Ford Global Technologies, Inc.

Against this background, it is submitted that the present invention is not anticipated in view of the disclosure of Strumolo et al. '300. The reference fails to disclose each and every element of the claimed combination of a method for designing a motor vehicle by enabling dynamic placement of paint spray particles into a flow domain to permit visual observation and alteration of resulting particle trajectories with respect to a computer aided design (CAD) model representative of the vehicle as claimed by Applicants. Therefore, it is respectfully submitted that claim 6 is not anticipated and is allowable over the rejection under 35 U.S.C. § 102(e).

35 U.S.C. § 103

As to patentability, 35 U.S.C. § 103 provides that a patent may not be obtained:

> If the differences between the subject matter sought to be patented and the prior art are such that the subject matter as a whole would have been obvious at the time the invention was made to a person having ordinary skill in the art to which said subject matter pertains. Id.

The United States Supreme Court interpreted the standard for 35 U.S.C. § 103 in Graham v. John Deere, 383 U.S. 1, 148 U.S.P.Q. 459 (1966). In Graham, the Court stated that under 35 U.S.C. § 103:

> The scope and content of the prior art are to be determined; differences between the prior art and the claims at issue are to be ascertained; and the level of ordinary skill in the pertinent art resolved. Against this background, the obviousness or non-obviousness of the subject matter is determined. 148 U.S.P.Q. at 467.

Using the standard set forth in Graham, the scope and content of the prior art relied upon by the Examiner will be determined.

As to the primary reference applied by the Examiner, Kinema/SIM Manual from ArSciMed discloses an interactive software tool that presents a simulation space where you can construct and animate complex physical phenomena. The basic building blocks are particles, sources, and obstacles.

As to the secondary reference applied by the Examiner, U.S. Patent No. 5,568,404 to Strumolo discloses a method and system for predicting sound pressure levels within a vehicle due to wind noise. The system and method includes a wind noise modeler, which is implemented as an Excel spreadsheet that runs on a PC.

In contradistinction, claim 1 claims the present invention as a system for designing a vehicle by enabling dynamic placement of paint spray particles into a flow domain to permit visual observation and alteration of resulting particle trajectories under a computed flow solution over a computer aided design (CAD) model representative of a desired portion of the vehicle represented on a display by a computer having memory, a processor and a user input mechanism associated therewith. The system includes spray gun placement code means operable with the user input mechanism to dynamically effect a desired placement of at least one paint spray gun on the display with respect to the desired portion of the CAD model. The system also includes trajectory determination code means for computing at least one trajectory for a particle stream

emanating from the at least one paint spray gun relative to the desired portion of the CAD model for a predetermined set of particle characteristics in a predetermined set of particle external conditions. The system further includes trajectory display code means for effecting display of the at least one trajectory with respect to the desired portion of the CAD model.

The United States Court of Appeals for the Federal Circuit (CAFC) has stated in determining the propriety of a rejection under 35 U.S.C. § 103(a), it is well settled that the obviousness of an invention cannot be established by combining the teachings of the prior art absent some teaching, suggestion or incentive supporting the combination. See In re Fine, 837 F.2d 1071, 5 U.S.P.Q.2d 1596 (Fed. Cir. 1988); Ashland Oil, Inc. v. Delta Resins & Refractories, Inc., 776 F.2d 281, 227 U.S.P.Q. 657 (Fed. Cir. 1985); ACS Hospital Systems, Inc. v. Montefiore Hospital, 732 F.2d 1572, 221 U.S.P.Q. 929 (Fed. Cir. 1984). The law followed by our court of review and the Board of Patent Appeals and Interferences is that " [a] prima facie case of obviousness is established when the teachings from the prior art itself would appear to have suggested the claimed subject matter to a person of ordinary skill in the art." In re Rinehart, 531 F.2d 1048, 1051, 189 U.S.P.Q. 143, 147 (C.C.P.A. 1976). See also In re Lalu, 747 F.2d 703, 705, 223 U.S.P.Q. 1257, 1258 (Fed. Cir. 1984) ("In determining whether a case of prima facie obviousness exists, it is necessary to ascertain whether the prior art teachings would appear to be sufficient to one of ordinary skill in the art to suggest making the claimed substitution or other modification.")

As to the differences between the prior art and the claims at issue, Kinema/SIM merely discloses an interactive software tool that presents a simulation space where you can construct and animate complex physical phenomena. Kinema/SIM does not disclose spray gun placement code means operable with a user input mechanism to dynamically effect a desired

placement of at least one paint spray gun on a display with respect to a desired portion of a CAD model and trajectory determination code means for computing at least one trajectory for a particle stream emanating from the at least one paint spray gun relative to the desired portion of the CAD model for a predetermined set of particle characteristics in a predetermined set of particle external conditions. The Examiner even admits on page 10 of the final Office Action that Kinema/SIM does not specifically teach simulating paint droplet particle flow past an automobile. Additionally, Kinema/SIM is related to the entertainment field and could not produce useful engineering results for an automotive application.

Strumolo '404 merely discloses a method and system for predicting sound pressure levels within a vehicle due to wind noise including a wind noise modeler, which is implemented as an Excel spreadsheet that runs on a PC. Strumolo '404 lacks spray gun placement code means operable with a user input mechanism to dynamically effect a desired placement of at least one paint spray gun on a display with respect to a desired portion of a CAD model and trajectory determination code means for computing at least one trajectory for a particle stream emanating from the at least one paint spray gun relative to the desired portion of the CAD model for a predetermined set of particle characteristics in a predetermined set of particle external conditions. The Examiner even admits on page 10 of the final Office Action that Strumolo et al. '404 does not teach particle trajectories of paint droplets. Additionally, in Strumolo et al. '404, the Exa CFD code, which refers to particles on a lattice, is merely a mathematical mechanism for conserving mass and momentum and there are no real particles therein.

Miller et al. '291 merely discloses transient CFD simulations of a bell sprayer in which two numerical models are required in order to analyze the effect of paint transfer efficiency

under varying bell operation conditions. Miller et al. '291 lacks spray gun placement code means operable with a user input mechanism to dynamically effect a desired placement of at least one paint spray gun on a display with respect to a desired portion of a CAD model. Contrary to the Examiner's opinion, Applicants are not claiming an intended use for their earlier disclosure relating to simulation of particle flow past a simulated automobile, but are claiming spray gun placement code means operable with a user input mechanism to dynamically effect a desired placement of at least one paint spray gun on a display with respect to a desired portion of a CAD model and trajectory determination code means for computing at least one trajectory for a particle stream emanating from the at least one paint spray gun relative to the desired portion of the CAD model for a predetermined set of particle characteristics in a predetermined set of particle external conditions, which are not found in the earlier disclosure. As such, there is no suggestion or motivation in the art to combine Kinema/SIM, Strumolo et al. '404, and Miller et al. '291 together. Further, Applicants disagree with the Examiner's motivation for his alleged combination, because the method and system of Applicants' invention enables dynamic placement of a paint spray gun into a flow domain to permit visual observation and alteration of resulting paint particle trajectories with respect to a CAD model representative of the vehicle and permits modification of vehicle design based upon computed particle trajectories with respect to a CAD model of the vehicle. Additionally, in Miller et al. '291, the SAE paper only describes the results of using a system, according to the present invention, and details of how the vehicle design is introduced, the flow fields calculated, and how one interacts with the system to produce an analysis (and modify the paint spray system for additional analyses) is not shown.

There is absolutely no teaching or suggestion in the art that to provide spray gun placement code means operable with a user input mechanism to dynamically effect a desired

placement of at least one paint spray gun on a display with respect to a desired portion of a CAD model and trajectory determination code means for computing at least one trajectory for a particle stream emanating from the at least one paint spray gun relative to the desired portion of the CAD model for a predetermined set of particle characteristics in a predetermined set of particle external conditions. The Examiner may not, because he/she doubts that the invention is patentable, resort to speculation, unfounded assumptions or hindsight reconstruction to supply deficiencies in the factual basis. See In re Warner, 379 F. 2d 1011, 154 U.S.P.Q. 173 (C.C.P.A. 1967).

Even if these references could be combined, neither teaches spray gun placement code means operable with a user input mechanism to dynamically effect a desired placement of at least one paint spray gun on a display with respect to a desired portion of a CAD model and trajectory determination code means for computing at least one trajectory for a particle stream emanating from the at least one paint spray gun relative to the desired portion of the CAD model for a predetermined set of particle characteristics in a predetermined set of particle external conditions. Applicants are not attacking the references individually, but are clearly pointing out that each reference is deficient and, if combined (although Applicants maintain that they are not combinable), the combination is deficient. The present invention sets forth a unique and non-obvious combination of a system that enables dynamic placement of a paint spray gun into a flow domain to permit visual observation and alteration of resulting paint particle trajectories with respect to a CAD model representative of the vehicle. The references, if combinable, fail to teach or suggest the combination of a paint spray particle trajectory analysis method and system including spray gun placement code means operable with a user input mechanism to dynamically effect a desired placement of at least one paint spray gun on a display with respect to a desired

portion of a CAD model and trajectory determination code means for computing at least one trajectory for a particle stream emanating from the at least one paint spray gun relative to the desired portion of the CAD model for a predetermined set of particle characteristics in a predetermined set of particle external conditions as claimed by Applicants. Thus, the Examiner has failed to establish a case of prima facie obviousness.

Against this background, it is submitted that the present invention of claim 1 is not obvious over Kinema/SIM, Strumolo et al. '404, and Miller et al. '291. The references fail to teach or suggest the combination of a system for designing a vehicle by enabling dynamic placement of paint spray particles into a flow domain to permit visual observation and alteration of resulting particle trajectories under a computed flow solution over a computer aided design (CAD) model representative of a desired portion of the vehicle represented on a display by a computer of claim 1. Therefore, it is respectfully submitted that claim 1 is not obvious and is allowable over the rejection under 35 U.S.C. § 103.

The law is clear that a claim in dependent form shall be construed to incorporate by reference all of the limitations of the claim to which it refers. 35 U.S.C. § 112, ¶ 4. Dependent claims 2 through 4 perfect and further limit independent claim 1. Claim 2 defines that the spray gun placement code means includes GUI means for displaying a spray gun GUI on the display, the GUI means operative with the input mechanism for locating the desired placement of the at least one paint spray gun. Claim 3 defines that the predetermined set of particle characteristics includes at least one of a set of particle diameter data, particle density data, and particle initial velocity data. Claim 4 defines that the trajectory display code means includes code means for displaying coordinate information of the display relative to the CAD model for intersection of the at least one trajectory with the desired portion of the vehicle. Based on the

above, it is respectfully submitted that claims 2 through 4 are not obvious and are allowable over the rejection under 35 U.S.C. § 103.

As to claim 5, claim 5 claims the present invention as a method for designing a vehicle using particle trajectory analysis with a computer aided design (CAD) model representative of the vehicle. The method includes the steps of preparing a CAD model of a desired portion of the vehicle and placing a paint spray gun at a desired location with respect to the desired portion of the vehicle. The method also includes the steps of specifying a set of particle information describing particles to be sprayed from the paint spray gun and computing a trajectory for a particle stream emanating from the paint spray gun. The method further includes the steps of displaying the trajectory relative to the desired portion of the vehicle on a display to permit visual observation thereof and repositioning the paint spray gun if necessary to achieve a desired trajectory.

As to the differences between the prior art and the claims at issue, Kinema/SIM merely discloses an interactive software tool that presents a simulation space where you can construct and animate complex physical phenomena. Kinema/SIM does not disclose preparing a CAD model of a desired portion of a vehicle, placing a paint spray gun at a desired location with respect to the desired portion of the vehicle, displaying the trajectory relative to the desired portion of the vehicle on a display to permit visual observation thereof, and repositioning the paint spray gun if necessary to achieve a desired trajectory. The Examiner even admits on page 10 of the final Office Action that Kinema/SIM does not specifically teach simulating paint droplet particle flow past an automobile. Additionally, Kinema/SIM is related to the entertainment field and could not produce useful engineering results for an automotive application.

Strumolo '404 merely discloses a method and system for predicting sound pressure levels within a vehicle due to wind noise including a wind noise modeler, which is implemented as an Excel spreadsheet that runs on a PC. Strumolo '404 lacks preparing a CAD model of a desired portion of a vehicle, placing a paint spray gun at a desired location with respect to the desired portion of the vehicle, displaying the trajectory relative to the desired portion of the vehicle on a display to permit visual observation thereof, and repositioning the paint spray gun if necessary to achieve a desired trajectory. The Examiner even admits on page 10 of the final Office Action that Strumolo et al. '404 does not teach particle trajectories of paint droplets. Additionally, in Strumolo et al. '404, the Exa CFD code, which refers to particles on a lattice, is merely a mathematical mechanism for conserving mass and momentum and there are no real particles therein.

Miller et al. '291 merely discloses transient CFD simulations of a bell sprayer in which two numerical models are required in order to analyze the effect of paint transfer efficiency under varying bell operation conditions. Miller et al. '291 lacks preparing a CAD model of a desired portion of a vehicle, placing a paint spray gun at a desired location with respect to the desired portion of the vehicle, displaying the trajectory relative to the desired portion of the vehicle on a display to permit visual observation thereof, and repositioning the paint spray gun if necessary to achieve a desired trajectory. Additionally, in Miller et al. '291, the SAE paper only describes the results of using a system, according to the present invention, and details of how the vehicle design is introduced, the flow fields calculated, and how one interacts with the system to produce an analysis (and modify the paint spray system for additional analyses) is not shown. As such, there is no motivation in the art to combine Kinema/SIM, Strumolo et al. '404, and Miller et al. '291 together.

There is absolutely no teaching or suggestion in the art of preparing a CAD model of a desired portion of a vehicle, placing a paint spray gun at a desired location with respect to the desired portion of the vehicle, displaying the trajectory relative to the desired portion of the vehicle on a display to permit visual observation thereof, and repositioning the paint spray gun if necessary to achieve a desired trajectory. The Examiner may not, because he/she doubts that the invention is patentable, resort to speculation, unfounded assumptions or hindsight reconstruction to supply deficiencies in the factual basis. See In re Warner, 379 F. 2d 1011, 154 U.S.P.Q. 173 (C.C.P.A. 1967).

Even if these references could be combined, neither teaches preparing a CAD model of a desired portion of a vehicle, placing a paint spray gun at a desired location with respect to the desired portion of the vehicle, displaying the trajectory relative to the desired portion of the vehicle on a display to permit visual observation thereof, and repositioning the paint spray gun if necessary to achieve a desired trajectory. Applicants are not attacking the references individually, but are clearly pointing out that each reference is deficient and, if combined (although Applicants maintain that they are not combinable), the combination is deficient. The present invention sets forth a unique and non-obvious combination of a method that enables dynamic placement of a paint spray gun into a flow domain to permit visual observation and alteration of resulting paint particle trajectories with respect to a CAD model representative of the vehicle. The references, if combinable, fail to teach or suggest the combination of a method for designing a vehicle using particle trajectory analysis with a computer aided design (CAD) model representative of the vehicle including the steps of preparing a CAD model of a desired portion of the vehicle, placing a paint spray gun at a desired location with respect to the desired portion of the vehicle, specifying a set of particle information

describing particles to be sprayed from the paint spray gun, computing a trajectory for a particle stream emanating from the paint spray gun, displaying the trajectory relative to the desired portion of the vehicle on a display to permit visual observation thereof, and repositioning the paint spray gun if necessary to achieve a desired trajectory as claimed by Applicants.

Further, the CAFC has held that "[t]he mere fact that prior art could be so modified would not have made the modification obvious unless the prior art suggested the desirability of the modification". In re Gordon, 733 F.2d 900, 902, 221 U.S.P.Q. 1125, 1127 (Fed. Cir. 1984). The Examiner has failed to show how the prior art suggested the desirability of modification to achieve Applicants' invention. Thus, the Examiner has failed to establish a case of prima facie obviousness.

Against this background, it is submitted that the present invention of claim 5 is not obvious over Kinema/SIM, Strumolo et al. '404, and Miller et al. '291. The references fail to teach or suggest the combination of a method for designing a vehicle using particle trajectory analysis with a computer aided design (CAD) model representative of the vehicle of claim 5. Therefore, it is respectfully submitted that claim 5 is not obvious and is allowable over the rejection under 35 U.S.C. § 103.

As to claim 6, claim 6 claims a method for designing a motor vehicle by enabling dynamic placement of paint spray particles into a flow domain to permit visual observation and alteration of resulting particle trajectories with respect to a computer aided design (CAD) model representative of the vehicle. The method includes the steps of storing a first set of data representing a CAD model of a desired portion of the vehicle into a computer memory and displaying the first set of data on a video display screen. The method also includes the steps of placing at least one paint spray gun at a desired location with respect to the desired portion of the

vehicle by storing a second set of data representing the at least one paint spray gun in the computer memory and storing a third set of data in the computer memory representing particle information describing particles to be sprayed from the paint spray gun. The method includes the steps of computing a fourth set of data representing a trajectory for a particle stream emanating from the paint spray gun using the first, second and third sets of data and displaying the fourth set of data representing a trajectory relative to the first set of data representing a desired portion of the vehicle on the video display screen to permit visual observation thereof. The method further includes the steps of dynamically repositioning the paint spray gun if necessary to achieve a desired trajectory by manipulating the second set of data in the computer memory.

As to the differences between the prior art and the claims at issue, Kinema/SIM merely discloses an interactive software tool that presents a simulation space where you can construct and animate complex physical phenomena. Kinema/SIM does not disclose storing a first set of data representing a CAD model of a desired portion of the vehicle into a computer memory, displaying the first set of data on a video display screen, placing at least one paint spray gun at a desired location with respect to the desired portion of the vehicle by storing a second set of data representing the at least one paint spray gun in the computer memory, storing a third set of data in the computer memory representing particle information describing particles to be sprayed from the paint spray gun, computing a fourth set of data representing a trajectory for a particle stream emanating from the paint spray gun using the first, second and third sets of data, displaying the fourth set of data representing a trajectory relative to the first set of data representing a desired portion of the vehicle on the video display screen to permit visual observation thereof, and dynamically repositioning the paint spray gun if necessary to achieve a desired trajectory by manipulating the second set of data in the computer memory. The Examiner

even admits on page 10 of the final Office Action that Kinema/SIM does not specifically teach simulating paint droplet particle flow past an automobile. Additionally, Kinema/SIM is related to the entertainment field and could not produce useful engineering results for an automotive application.

Strumolo '404 merely discloses a method and system for predicting sound pressure levels within a vehicle due to wind noise including a wind noise modeler, which is implemented as an Excel spreadsheet that runs on a PC. Strumolo '404 lacks storing a first set of data representing a CAD model of a desired portion of the vehicle into a computer memory, displaying the first set of data on a video display screen, placing at least one paint spray gun at a desired location with respect to the desired portion of the vehicle by storing a second set of data representing the at least one paint spray gun in the computer memory, storing a third set of data in the computer memory representing particle information describing particles to be sprayed from the paint spray gun, computing a fourth set of data representing a trajectory for a particle stream emanating from the paint spray gun using the first, second and third sets of data, displaying the fourth set of data representing a trajectory relative to the first set of data representing a desired portion of the vehicle on the video display screen to permit visual observation thereof, and dynamically repositioning the paint spray gun if necessary to achieve a desired trajectory by manipulating the second set of data in the computer memory. The Examiner even admits on page 10 of the final Office Action that Strumolo et al. '404 does not teach particle trajectories of paint droplets. Additionally, in Strumolo et al. '404, the Exa CFD code, which refers to particles on a lattice, is merely a mathematical mechanism for conserving mass and momentum and there are no real particles therein.

Miller et al. '291 merely discloses transient CFD simulations of a bell sprayer in which two numerical models are required in order to analyze the effect of paint transfer efficiency under varying bell operation conditions. Miller et al. '291 lacks storing a first set of data representing a CAD model of a desired portion of the vehicle into a computer memory, displaying the first set of data on a video display screen, placing at least one paint spray gun at a desired location with respect to the desired portion of the vehicle by storing a second set of data representing the at least one paint spray gun in the computer memory, storing a third set of data in the computer memory representing particle information describing particles to be sprayed from the paint spray gun, computing a fourth set of data representing a trajectory for a particle stream emanating from the paint spray gun using the first, second and third sets of data, displaying the fourth set of data representing a trajectory relative to the first set of data representing a desired portion of the vehicle on the video display screen to permit visual observation thereof, and dynamically repositioning the paint spray gun if necessary to achieve a desired trajectory by manipulating the second set of data in the computer memory. Additionally, in Miller et al. '291, the SAE paper only describes the results of using a system, according to the present invention, and details of how the vehicle design is introduced, the flow fields calculated, and how one interacts with the system to produce an analysis (and modify the paint spray system for additional analyses) is not shown. As such, there is no motivation in the art to combine Kinema/SIM, Strumolo et al. '404, and Miller et al. '291 together.

There is absolutely no teaching or suggestion in the art of storing a first set of data representing a CAD model of a desired portion of the vehicle into a computer memory, displaying the first set of data on a video display screen, placing at least one paint spray gun at a desired location with respect to the desired portion of the vehicle by storing a second set of data

representing the at least one paint spray gun in the computer memory, storing a third set of data in the computer memory representing particle information describing particles to be sprayed from the paint spray gun, computing a fourth set of data representing a trajectory for a particle stream emanating from the paint spray gun using the first, second and third sets of data, displaying the fourth set of data representing a trajectory relative to the first set of data representing a desired portion of the vehicle on the video display screen to permit visual observation thereof, and dynamically repositioning the paint spray gun if necessary to achieve a desired trajectory by manipulating the second set of data in the computer memory. The Examiner may not, because he/she doubts that the invention is patentable, resort to speculation, unfounded assumptions or hindsight reconstruction to supply deficiencies in the factual basis. See In re Warner, 379 F. 2d 1011, 154 U.S.P.Q. 173 (C.C.P.A. 1967).

Even if these references could be combined, neither teaches storing a first set of data representing a CAD model of a desired portion of the vehicle into a computer memory, displaying the first set of data on a video display screen, placing at least one paint spray gun at a desired location with respect to the desired portion of the vehicle by storing a second set of data representing the at least one paint spray gun in the computer memory, storing a third set of data in the computer memory representing particle information describing particles to be sprayed from the paint spray gun, computing a fourth set of data representing a trajectory for a particle stream emanating from the paint spray gun using the first, second and third sets of data, displaying the fourth set of data representing a trajectory relative to the first set of data representing a desired portion of the vehicle on the video display screen to permit visual observation thereof, and dynamically repositioning the paint spray gun if necessary to achieve a desired trajectory by manipulating the second set of data in the computer memory. Applicants are not attacking the

references individually, but are clearly pointing out that each reference is deficient and, if combined (although Applicants maintain that they are not combinable), the combination is deficient. The present invention sets forth a unique and non-obvious combination of a method that enables dynamic placement of a paint spray gun into a flow domain to permit visual observation and alteration of resulting paint particle trajectories with respect to a CAD model representative of the vehicle. The references, if combinable, fail to teach or suggest the combination of a method for designing a motor vehicle by enabling dynamic placement of paint spray particles into a flow domain to permit visual observation and alteration of resulting particle trajectories with respect to a computer aided design (CAD) model representative of the vehicle including the steps of storing a first set of data representing a CAD model of a desired portion of the vehicle into a computer memory, displaying the first set of data on a video display screen, placing at least one paint spray gun at a desired location with respect to the desired portion of the vehicle by storing a second set of data representing the at least one paint spray gun in the computer memory, storing a third set of data in the computer memory representing particle information describing particles to be sprayed from the paint spray gun, computing a fourth set of data representing a trajectory for a particle stream emanating from the paint spray gun using the first, second and third sets of data, displaying the fourth set of data representing a trajectory relative to the first set of data representing a desired portion of the vehicle on the video display screen to permit visual observation thereof, and dynamically repositioning the paint spray gun if necessary to achieve a desired trajectory by manipulating the second set of data in the computer memory as claimed by Applicants. The Examiner has failed to establish a case of prima facie obviousness.

Obviousness under § 103(a) is a legal conclusion based on factual evidence (In re Fine, 837 F.2d 1071, 1073, 5 U.S.P.Q.2d 1596, 1598 (Fed. Cir. 1988)), and the subjective opinion of the Examiner as to what is or is not obvious, without evidence in support thereof, does not suffice. The Examiner may not, because he/she doubts that the invention is patentable, resort to speculation, unfounded assumptions or hindsight reconstruction to supply deficiencies in the factual basis. See In re Warner, 379 F. 2d 1011, 154 U.S.P.Q. 173 (C.C.P.A. 1967). Because the Examiner has not provided a sufficient factual basis that is supportive of his/her position (see In re Warner, 379 F.2d 1011, 1017, 154 U.S.P.Q. 173, 178 (C.C.P.A. 1967), cert. denied, 389 U.S. 1057 (1968)), the rejection of claim 6 is improper.

Against this background, it is submitted that the present invention of claim 6 is not obvious over Kinema/SIM, Strumolo et al. '404, and Miller et al. '291. The references fail to teach or suggest the combination of a method for designing a motor vehicle by enabling dynamic placement of paint spray particles into a flow domain to permit visual observation and alteration of resulting particle trajectories with respect to a computer aided design (CAD) model representative of the vehicle of claim 6. Therefore, it is respectfully submitted that claim 6 is not obvious and is allowable over the rejection under 35 U.S.C. § 103.

In conclusion, it is respectfully submitted that the rejections of claims 1 through 6 are improper and should be reversed.

Respectfully submitted,

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APPENDIX

The claims on appeal are as follows:

1. A system for designing a vehicle by enabling dynamic placement of paint spray particles into a flow domain to permit visual observation and alteration of resulting particle trajectories under a computed flow solution over a computer aided design (CAD) model representative of a desired portion of the vehicle represented on a display by a computer having memory, a processor and a user input mechanism associated therewith, said system comprising:

spray gun placement code means operable with the user input mechanism to dynamically effect a desired placement of at least one paint spray gun on the display with respect to the desired portion of the CAD model;

trajectory determination code means for computing at least one trajectory for a particle stream emanating from the at least one paint spray gun relative to the desired portion of the CAD model for a predetermined set of particle characteristics in a predetermined set of particle external conditions; and

trajectory display code means for effecting display of the at least one trajectory with respect to the desired portion of the CAD model.

2. A system as set forth in claim 1 wherein the spray gun placement code means includes GUI means for displaying a spray gun GUI on the display, the GUI means operative with the input mechanism for locating the desired placement of the at least one paint spray gun.

3. A system as set forth in claim 1 wherein the predetermined set of particle characteristics includes at least one of a set of particle diameter data, particle density data, and particle initial velocity data.

4. A system as set forth in claim 1 wherein the trajectory display code means includes code means for displaying coordinate information of the display relative to the CAD model for intersection of the at least one trajectory with the desired portion of the vehicle.

5. A method for designing a vehicle using particle trajectory analysis with a computer aided design (CAD) model representative of the vehicle, said method comprising the steps of:

preparing a CAD model of a desired portion of the vehicle;

placing a paint spray gun at a desired location with respect to the desired portion of the vehicle;

specifying a set of particle information describing particles to be sprayed from the paint spray gun;

computing a trajectory for a particle stream emanating from the paint spray gun;

displaying the trajectory relative to the desired portion of the vehicle on a display to permit visual observation thereof; and

repositioning the paint spray gun if necessary to achieve a desired trajectory.

6. A method for designing a motor vehicle by enabling dynamic placement of paint spray particles into a flow domain to permit visual observation and alteration of resulting

particle trajectories with respect to a computer aided design (CAD) model representative of the vehicle, said method comprising the steps of:

storing a first set of data representing a CAD model of a desired portion of the vehicle into a computer memory;

displaying the first set of data on a video display screen;

placing at least one paint spray gun at a desired location with respect to the desired portion of the vehicle by storing a second set of data representing the at least one paint spray gun in the computer memory;

storing a third set of data in the computer memory representing particle information describing particles to be sprayed from the paint spray gun;

computing a fourth set of data representing a trajectory for a particle stream emanating from the paint spray gun using the first, second and third sets of data;

displaying the fourth set of data representing a trajectory relative to the first set of data representing a desired portion of the vehicle on the video display screen to permit visual observation thereof; and

dynamically repositioning the paint spray gun if necessary to achieve a desired trajectory by manipulating the second set of data in the computer memory.